Analyzing the Effectiveness of a Meatless Monday Intervention on Meat Consumption and Associated Pro-Environmental Spillover Behavior Throughout the Week

Undergraduate Research Thesis

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by

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Abstract

A global reduction in meat consumption has been identified as a critical strategy to mitigate the impacts of climate change, as well as to maintain sustainable land and water systems. Several forms of interventions have promoted reduced meat consumption, with varying success rates.

One such strategy is Meatless Monday (MM), a campaign encouraging abstention from meat consumption on Mondays for environmental and health reasons. Little experimental research has been conducted regarding the effectiveness of the campaign, or of meat consumption reduction interventions generally.

Another area warranting additional research is that of behavioral spillover, especially as related to pro-environmental behavior (PEB). Behavioral spillover has been defined as the effect of an intervention on subsequent behaviors not targeted by the intervention (e.g., a household recycling intervention motivating increased energy conservation rates).

This study addressed such research gaps by testing whether an intervention encouraging participation in MM would lead to significantly reduced meat consumption on Monday and during the rest of a given week, as well as to higher performance rates of other PEBs during that week (i.e., behavioral spillover). We hypothesized that each effect would be observed.

The sample consisted of students enrolled in OSU undergraduate courses (n = 111). Participants were randomly assigned into control and experimental groups, and completed a baseline survey assessing meat consumption and PEBs performed, among other variables. The experimental group also received a digital flyer encouraging participation in MM. Both groups then completed food diaries assessing meat consumption for one week, and a follow-up survey assessing PEBs performed and other factors during that week.

Subsequent analyses led to all three hypotheses being rejected. In fact, the experimental group reported higher week-level meat consumption, potentially due to failed baseline randomization. Future research is warranted to identify factors that may make meat consumption reduction interventions more effective, and to determine conditions under which pro-environmental behavioral spillover may occur.

Introduction

Study Objectives

This study aimed to address research gaps related to the effectiveness of meat consumption reduction interventions, specifically the Meatless Monday campaign, in motivating reduced meat consumption for the purposes of environmental benefit. It also investigated the phenomenon of pro-environmental behavioral spillover, assessing the extent to which an intervention promoting Meatless Monday can lead to other pro-environmental behaviors not targeted by the intervention.

Literature Review

Environmental Impacts of Meat Consumption and Diet

Significant reduction in greenhouse gas emissions (GHGes) are necessary if we are to limit the global average temperature increase to well below 2°C, the goal set forth in the Paris Agreement (Schleussner et al., 2016). To achieve these reductions, it is critical that we not only transform energy and transportation infrastructure, as is commonly proposed, but also our diets, so as to decrease consumption of meat and other animal products. Indeed, in its 2018 report on global warming, the IPCC identified the reduction of meat consumption as an important strategy to reduce emissions and thus mitigate the impacts of climate change (de Coninck et al., 2018).

It has been estimated that approximately 14.5% of global GHGes can be attributed to the livestock sector annually, amounting to over 7 gigatons of CO_2-equivalent (Gerber et al., 2013). Among the many reasons for this substantial carbon footprint is the fact that meat production is highly inefficient, as plant material is fed to livestock, which is then fed to humans, rather than feeding plant material directly to humans. Indeed, a 2013 study calculated that an average of 27 lbs of plant biomass are required for every pound of meat (Smith et al., 2013).

This inefficiency means that significantly greater fossil fuel energy inputs are required for animal protein production than are required for plant protein production, at an estimated ratio

of 11 to 1 (Pimentel & Pimentel, 2003). The potential for reduction in GHGes by way of decreased meat consumption is therefore significant. In an analysis of the climate change impacts of global dietary change, it was found that transitioning toward more plant-based diets that align with standard dietary guidelines could reduce food-related GHGes by up to 70%, when compared to a 2050 reference scenario (Springmann et al., 2016).

However, it is also important to note that reduced meat consumption may address a host of other environmental challenges outside of global warming and GHGes, including land degradation, biodiversity loss, and water scarcity, among others. The vast area required for pasture makes meat production highly land-intensive, with pasture covering more than double the area of global ice-free land that cropland covers, and with a third of that cropland being used solely for feed crops (FAO, 2011). This ratio of land usage is particularly problematic in the Amazon rainforest, where it has been estimated that over 75% of all deforested lands have been converted to livestock pasture and feed crop production (Nepstad, Stickler, & Soares-Filho, 2008). As a major source of both biodiversity and carbon sequestration, the Amazon rainforest must be preserved to mitigate further environmental damage, which can be achieved in part by reducing meat consumption, thus obviating the need to convert more rainforest to pasture.

Meat production is also highly water-intensive, due to the significant water footprints of feed crops and the livestock itself. 29% of the total water footprint of the global agricultural sector has been attributed to animal production, comprising over 15% of global freshwater use. Furthermore, it has been estimated that over 1,800 gallons of water may be required to produce a single pound of beef, and over 500 gallons of water for a single pound of chicken, as compared to 115 gallons for a pound of fruit and 39 gallons for a pound of vegetables (Mekonnen & Hoekstra, 2010).

When considering these and other environmental impacts in aggregate, it is evident that a diet composed of fewer animal products is more environmentally sustainable, while offering far greater potential to address global food security challenges (Smith et al., 2013). Indeed, in a comparison of the environmental impacts of vegetarian and nonvegetarian diets in California, it was found that nonvegetarian diets required 2.9 times more water, 2.5 times more primary energy, 13 times more fertilizer, and 1.4 times more pesticides than that of vegetarian diets (Marlow et al., 2009). Additionally, in a larger review of 63 studies related to the adoption of

sustainable diets, the largest environment benefits, including GHGes, land use, and water use, were witnessed in those diets that most reduced the amount of animal-based foods consumed (e.g., pescatarian, vegetarian, and vegan diets) (Aleksandrowicz et al., 2016).

The Meatless Monday Movement

In light of these environmental impacts, many strategies have been proposed to encourage consumers to reduce their personal meat consumption. One such strategy is Meatless Monday. Launched in 2003, Meatless Monday is a global initiative with a simple message: one day per week, don't eat meat. The movement was founded in collaboration with the Center for a Livable Future at the Johns Hopkins Bloomberg School of Public Health, as one of its Healthy Monday initiatives, which encourage consumers to make healthier decisions at the beginning of each week. The movement has the goal of facilitating a 15% reduction in meat consumption for both environmental and health reasons (Clark, 2016).

The movement focuses on Monday in large part due to the "fresh start effect," which refers to the phenomenon that people are more likely to engage in aspirational behaviors following temporal landmarks, such as the beginning of a new week. Behavioral researchers at the University of Pennsylvania found evidence for this effect among such behaviors as dieting, gym attendance, and the creation of commitment contracts (Dai, Milkman, & Riis, 2014). Other studies found that smoking cessation Google search queries on Monday were 25% higher than the combined mean for Tuesday through Sunday (Ayers, Althouse, & Johnson, 2014a), and that health-related queries were the highest on Monday and Tuesday (Ayers, Althouse, & Johnson, 2014b), thus providing evidence for this effect. Indeed, while some people report that Monday is "a day to dread," many people see Monday positively, viewing the day as an opportunity for a "fresh start" and to "get their acts together" (Data Decisions Group, 2017). Other stated reasons for focusing on Monday include the need to distance the meatless day from Friday, which is traditionally already a meat-free day among Catholics and Orthodox Christians, and the idea that weekly reminders to restart healthy habits may encourage success (Clark, 2016).

There is evidence that awareness of Meatless Monday has grown markedly in the United States over time. According to a nationally representative sample of over 1,000 American adults,

over 50% of Americans were aware of Meatless Monday by 2011 (FGI Research, 2011). A follow-up study in 2012 found that of those aware of Meatless Monday, 62% reportedly had attempted to incorporate the movement into their weekly routines, and 40% reportedly had incorporated more meatless meals into their diets during the rest of the week as a result (FGI Research, 2012). However, it should be noted that this research has not been peer-reviewed and thus should not be considered as credible as comparable peer-reviewed literature. Indeed, there does not appear to be any existing peer-reviewed research analyzing responses to Meatless Monday messaging in an empirical, quantitative manner, a notable research gap to be addressed.

Furthermore, while numerous surveys have been administered regarding the general effectiveness of Meatless Monday (e.g., Leidig, 2012), it does not appear that any experimental research has been conducted to ascertain the specific impacts that the Meatless Monday campaign has on actual individual meat consumption behavior (e.g., in the form of food diaries). This research gap is due in part to the inherent challenges of accurately tracking meat consumption and of causally attributing such behavior to Meatless Monday messaging (Chan & Ramsing, 2017). Indeed, the vast majority of existing research related to Meatless Monday has been limited to qualitative descriptions of the movement's origins (e.g., Clark, 2016), examinations of its potential generalized role in mediating climate change (e.g., Doyle, 2011), and practical tips for more effective implementation in specific dining settings (e.g., Chan & Ramsing, 2017). Therefore, a more quantitative examination of Meatless Monday by means of an experimental design is warranted, as will be conducted in this study.

Consumer Attitudes Towards Meat Consumption

It is important also to note that while awareness of Meatless Monday has likely grown over time, consumer attitudes towards efforts to reduce meat consumption remain highly variable. One consistent finding, however, is that consumers generally underestimate the environmental impacts of livestock production (Vanhonacker, Van Loo, & Gellynck, 2013). A 2011 study found that consumers believe that, among potential ecological food consumption behaviors, avoiding excessive packaging had the most significant pro-environmental impact, whereas reducing meat

consumption and purchasing organic food had the least impact (Tobler, Visschers, & Siegrist, 2011). Similarly, in focus group discussions assessing public attitudes towards the environmental impacts of meat consumption, researchers found that participants exhibited a significant lack of awareness of the association between meat consumption and climate change, and a general perception that personal meat consumption behavior plays only a minimal role in the global context of climate change (Macdiarmid, Douglas, & Campbell, 2016). Additionally, a recent international survey found that while 83% of respondents agreed that human activity is contributing to climate change, only 30% perceived meat and livestock production to be a significant contributor (Bailey, Froggatt, & Wellesley, 2014).

Furthermore, evidence has suggested that consumers are not primarily motivated by environmental impact when forming intentions to reduce meat consumption. Rather, consumers may be more motivated by health considerations than by environmental considerations when choosing to engage in such behavior (Latvala et al., 2012). Lending further support to this finding was a recent nationally-representative survey of U.S. adults, which found that the most commonly cited reasons for reducing meat consumption were cost and health, whereas environmental and animal welfare reasons were less influential (Neff, Edwards, & Palmer, 2018).

Perceived barriers to reducing meat consumption are numerous and varied. In 2017, German researchers published a systematic meta-analysis of relevant studies, revealing that a host of interrelated factors function as barriers to reducing meat consumption (Stoll-Kleemann & Schmidt, 2017). Many people lack sufficient knowledge of the consequences of high meat consumption, or of the necessary skills to change one's diet, including meatless cooking skills. Others utilize denial and defense mechanisms to distance themselves psychologically from the potential behavior change, or cite a lack of availability of vegetarian options where they shop or reside. Still others maintain their current rates of meat consumption due to daily habits, a preference for the taste of meat (Lea & Worsley, 2003), or financial considerations, due in part to economic subsidies supporting the livestock industry and thus driving consumer prices down. Indeed, these factors and others work together to maintain a relative status quo of meat consumption, with large-scale infrastructure change needed to facilitate plant-based eating on a broader scale (Stoll-Kleemann & Schmidt, 2017).

Meat Consumption Reduction Interventions

While meat consumption reduction interventions represent a relatively novel area of research interest, multiple approaches have been experimentally tested, with mixed results. For example, many such interventions have focused on restructuring the physical micro-environments that individuals encounter when making decisions regarding meat consumption. A recent systematic review of such interventions found that this kind of physical restructuring may help to promote reduced demand for meat consumption, specifically including those interventions which reduced meat serving portion sizes, provided meal alternatives, or changed the sensory properties of meat (Bianchi et al., 2018). The effectiveness of informational and emotional messaging has also been evaluated in experimental settings, with the latter in particular having been associated with reduced meat consumption in certain contexts (e.g., Carfona, Bertolotti, & Catellani, 2019).

Many interrelated factors may contribute to the success or failure of meat consumption reduction interventions. In a recent study, it was found that perceived behavioral control, attitudes, personal norms, and problem-awareness all significantly impact the phase of behavioral change (including pre-decision, pre-action, action, and post-action phases) an individual may have achieved when considering reductions in meat consumption. Additionally, factors such as female gender and increased education were correlated with the probability of belonging to a phase of behavioral change, and the achievement of higher such phases, respectively (Weibel, Ohnmacht, & Schaffner, 2019). In another study, a multicomponent intervention, the informational component (i.e., increasing awareness of the negative impacts of meat consumption) was identified by participants as most effective in leading to reductions in meat consumption, when compared to social norm, fear, and goal-setting components (Amiot, El Hajj Boutros, & Sukhanova, 2018). Past purchasing experiences that were rewarding to consumers may also predict future purchasing and consumption of sustainable foods, including those without meat (Vassallo, Scalvedi, & Saba, 2015). However, even when effective, meat reduction interventions, particularly ones that encourage adherence to a “meatless day,” are not without their flaws, as participants may replace meat with increased consumption of products

that still have significant negative environmental impacts, such as eggs (de Boer, Schösler, & Aiking, 2014).

In spite of these diverse findings, research gaps still remain in relation to meat consumption reduction interventions generally, with little research having been conducted to investigate the factors that may render them more or less effective (Amiot, El Hajj Boutros, & Sukhanova, 2018). Thus, further experimental research investigating meat consumption reduction interventions is warranted.

Behavioral Spillover and Pro-Environmental Behavior

Another area of interest when considering meat consumption reduction interventions concerns the effects of such interventions on other related behaviors, known as behavioral spillover. Behavioral spillover, a phenomenon to which many different labels have been historically been attached (Austin et al., 2011), is a relatively novel area of interest within psychology and behavioral science generally. It can be broadly defined as an "effect of an intervention on subsequent behaviors not targeted by the intervention" (Truelove et al., 2014), though definitions may vary. An example of behavioral spillover might be the effect of a household energy consumption intervention on recycling rates. Both positive and negative spillover can occur, with positive spillover representing an increase in frequency of the non-targeted behavior, and negative spillover representing a decrease in frequency. Within the context of the aforementioned example, increased recycling rates as a result of the energy consumption intervention would represent positive spillover, with decreased recycling rates representing negative spillover.

Indeed, a significant area of interest within spillover research relates to pro-environmental behavior (PEB), as researchers and policymakers seek to understand how positive spillover can be utilized to create more effective PEB interventions, as well as how to quantify and minimize negative spillover effects associated with such interventions. While a variety of PEBs have been studied in recent years, no research appears to have been conducted exploring behavioral spillover within the context of Meatless Monday. Questions exist as to whether adoption of Meatless Monday can lead to positive spillover within the same behavioral domain (e.g., eating

more organic food) or among other PEB domains (e.g, sorting recycling), or perhaps whether adoption of such a change may actually cause negative spillover in relation to other PEBs. These intriguing questions will be addressed in this study.

Environmental Identity

There have been numerous interrelated theoretical pathways proposed that may contribute to spillover effects. In regard to this particular study, one salient mechanism relates to identity, specifically environmental identity. This theoretical pathway refers to the idea that interventions encouraging PEB may either strengthen one's environmental identity (if the behavior is adopted), or weaken it (if it is not adopted), leading to positive or negative spillover, respectively. This pathway has received a relatively large amount of scholarly attention and support when compared to other proposed PEB spillover pathways, and has been demonstrated to be a significant predictor for several forms of PEBs (Whitmarsh & O'Neill, 2010).

For example, in a recent study of such behaviors, it was found that attaching environmentalist labels to individuals who performed PEBs led to increased rates of positive spillover (Lacasse, 2016). This finding can be explained in part by consistency theory, which notes that humans have an internal desire to reduce cognitive dissonance by acting consistently with their belief and identities (Festinger, 1957). This desire to avoid inconsistency has indeed been found to be an important factor in shaping pro-environmental behavior (Thøgersen, 2004), as an individual with an established environmental identity will seek to behave in a manner consistent with being an environmentalist (Van der Werff, Steg, & Keizer, 2013), and vice versa.

The identity effect does not function as a binary influence on future PEBs, but rather functions as a continuum. The strength with which a PEB signals that one is a pro-environmental person has been demonstrated to influence the effect on one's environmental identity, with stronger signaling leading to increased strengthening in one's identity (Van der Werff, Steg, & Keizer, 2014). Relevant to this study, the extent to which engaging in Meatless Monday signals that one is a pro-environmental person may vary based on multiple factors, such as past meat consumption behavior and motivations for engaging in the campaign.

One particularly intriguing study explored such identity effects within the context of a meat reduction program being implemented in a private sector company, albeit with a relatively small participant sample size (*n* = 13). The study was based upon principles of identity process theory, which seeks to explain how people respond to changes in their physical and social environments, either coping with such changes or integrating them into their identities. Using these ideas, the study proposed a conceptual framework for explaining how individuals may react to the information of an environmental behavior change intervention (BCI), in regards to identity.

Three distinct response pathways arose: integration, compartmentalization, and conflict. Integration referred to when the content of the BCI became more central to individuals, leading to strengthening of environmental identity, consistent performance of PEBs, and *positive spillover.* Compartmentalization referred to when the content of the BCI became neither more or less central to individuals, leading to separation of the behavior from environmental identity, one-off behavior, and a *lack of spillover*. Finally, conflict (conflict identities) referred to when the content of the BCI became less central to individuals, leading to weakening of environmental identity, reactive behavior, and *negative spillover* (Verfeuth et al., 2019).

This 2019 study, while limited in sample size, is indeed relevant to the present study, as it proposed a framework of connecting environmentalist identity and behavioral spillover within the context of a meat reduction program, and more specifically, proposed explanatory pathways by which positive and negative spillover effects may occur (or lack thereof). However, it should be noted that the findings of this 2019 study were generated primarily from qualitative data, having been collected primarily from semi-structured interviews, and a non-experimental study design. Therefore, the present study will incorporate and expand upon the above ideas, utilizing a more quantitative approach and an experimental design that will address many of the 2019 study's limitations.

Behavioral Difficulty

Another important factor to consider in relation to identity is that of behavioral difficulty. This is because perceived behavioral difficulty of an initial behavior targeted by an intervention has been shown to influence the extent to which identity is amplified, and thus the extent to which spillover may occur. For example, in a study of charitable donations and honesty,

researchers found that pro-social identity was strengthened only when the initial charitable donations were perceived to be difficult, increasing subsequent honesty, a form of positive spillover (Gneezy et al., 2012). However, studies of behavioral difficulty also apply directly to environmental decision-making. Indeed, it has been proposed that initial behaviors representing high perceived behavioral difficulty lead to increased strengthening of environmental identity, and thus increased rates of positive spillover (Truelove et al., 2014). Support for this effect was found in a study linking household composting, a perceivedly difficult behavior (Truelove & Gillis, 2018), with positive spillover related to energy and waste prevention (Sintov, Geislar, & White, 2017).

However, Truelove et al. noted that highly difficult initial behaviors may also lead to negative spillover when performed. In such situations, individuals may utilize the mental approach known as moral licensing, which refers to the tendency to use past good deeds to justify future behaviors that may be more problematic (Monin & Miller, 2001). For example, if an individual engaged in the relatively difficult action of installing new rooftop solar panels, that individual may then feel that it is more morally permissible to abstain from recycling, due to the fact that he or she had already completed a difficult pro-environmental behavior.

When considering meat consumption reduction interventions, behavioral difficulty is quite relevant, insofar as reducing meat consumption (or eliminating it completely on Mondays) may be perceived to be a difficult initial behavior. Inconvenience, affinity for meat taste, and protein consumption preferences are among the numerous potential barriers to reducing meat consumption, all of which may significantly increase behavioral difficulty, and, depending on how such difficulty is perceived, may amplify either positive or negative spillover effects.

Research Questions

Given the urgent need for the widespread adoption of PEBs, the significant pro-environmental benefits of reduced meat consumption, and the many unknowns of meat consumption reduction interventions, specifically in regard to Meatless Monday, additional research is warranted to investigate the effectiveness of such interventions. Furthermore, while numerous potentially interrelated theoretical pathways to explain spillover within the context of PEB have been proposed, evidence of actual spillover effects has been mixed (Maki et al., 2019). Additional research is therefore warranted to determine the extent to which pro-environmental spillover behavior may actually occur. In response to such needs, the following research questions (RQs) arose:

Will individuals who receive an intervention encouraging participation in Meatless Monday…

RQ1 *…consume significantly less meat on Monday, relative to no-intervention controls?*
RQ2*…consume significantly less meat during the rest of the week, relative to controls?*
RQ3 *…perform significantly more PEBs throughout the week, relative to controls?*

Hypotheses

Based on a review of the literature, the following hypotheses were made:

Individuals who receive an intervention encouraging participation in Meatless Monday will...

H1*: …consume significantly less meat on Monday, relative to no-intervention controls.*
H2*: …consume significantly less meat during the rest of the week, relative to controls.*
H3*: …perform significantly more PEBs throughout the week, relative to controls.*

Methods

Participants

Recruitment and Incentives

Students were recruited to participate in this research study from among four semester-long undergraduate courses offered in the School of Environment and Natural Resources (SENR) at The Ohio State University. These courses included ENR 2300 ("Society and Natural Resources"), RURLSOC 1500 ("Introduction to Rural Sociology"), ENR 3200 ("Environmental and Natural Resources Policy"), and ENR 3400 ("Psychology of Environmental Problems").

Students were offered 1.25% extra credit towards their course grades in exchange for participation in the study. Additionally, participants were entered into a randomized raffle drawing to win a $75 gift card to a retail location of their choice, receiving one entry into the drawing for each food diary completed (up to 7), thus incentivizing participants to complete food diaries (discussed in the "Procedure" and "Measures" sections).

Sample

A total of 159 individual participants completed the initial survey. 4 participants were excluded from the sample due to procedural errors (i.e., not including an identifier, erroneously completing survey measures twice with conflicting results). An additional 44 participants were omitted from the sample because they satisfied one or more of the following exclusionary criteria: (1) identified as "vegan," "vegetarian," or "almost vegetarian"- 31 participants; (2) completed fewer than five food diaries- 18 participants; (3) failed an attention check- 1 participant.

Therefore, the final sample for H1 and H2 was n = 111, with 58 (52.3%) and 53 (47.8%) participants having been randomly assigned to the control and experimental groups, respectively. It should be noted that six participants who did not complete the follow-up survey were still included in this sample of n = 111, due to the fact that testing for H1 and H2 (i.e., meat

consumption rate on Monday and throughout the rest of the week) did not require completion of the follow-up survey.

However, because testing for H3 (i.e., rate of PEBs performed throughout the week) did require completion of the follow-up survey, these six participants were excluded from the H3 sample. The sample for H3 therefore was n = 105, with 57 (54.3%) and 48 (45.7%) participants having been randomly assigned to the control and experimental groups, respectively.

Demographics

Demographics were computed for the larger sample (n = 111). The mean age was 20.5 years old, with participant ages ranging from 18 to 34 years old. An independent samples t-test ($t(108.6)$[1] = 1.44; p = .152) affirmed that mean ages did not differ significantly between control ($\bar{x}$ = 20.8, σ = 2.8)[2] and experimental ($\bar{x}$ = 20.1, σ = 2.4) groups.

In regards to gender, 33 (29.7%) participants identified as “male," 76 (68.5%) as “female," and 2 (1.8%) as “other”/non-binary . A chi-square test affirmed that gender distribution did not differ significantly between experimental and control groups (χ^2 = 2.59; p = .274).

Racially, participants were asked to identify as one or more of the following options: “white,” “black or African American,” “Native American or Alaska native,” “Asian,” “Native Hawaiian or Pacific Islander,” or “other.” 95 (85.6%) participants identified as white only, 6 (5.4%) as Asian only, and 10 (9.0%) as mixed race. The responses were therefore recoded into three categories (white only = 1, Asian only = 2, and mixed race = 3) to reflect these differences. After recoding, a chi-square test affirmed that racial distribution did not differ significantly between experimental and control groups (χ^2 = 1.11; p = .575).

Regarding fields of study, 58 (52.3%) participants were pursuing majors with either the word “environment” or “environmental” in the title, with many others pursuing related fields of study within SENR, including “forestry, fisheries, & wildlife,” and “natural resource management." However, there were also a number of participants pursuing majors in vastly unrelated fields,

[1] For all independent samples t-tests conducted in this study, equal variances between samples were not assumed. This led to degrees of freedom (the value within the parentheses) being computed as a decimal value for each such test, as a feature of the statistical software being used (IBM SPSS Statistics).

[2] For this study, the symbols $\bar{x}$ and σ represent sample mean and standard deviation, respectively.

including computer science, music, nursing, political science, and mechanical engineering. The responses were therefore recoded into a new binary variable, "major within SENR," with responses of 1 representing participants who reported pursuing at least one major within SENR, and of 0 representing participants who did not. An independent samples t-test affirmed that the proportion of participants pursuing majors within SENR did not differ significantly between treatment groups ($t(106.5) = .478$, $p = .633$).

Politically, 74 (66.7%) identified as either "very liberal," "liberal," or "somewhat liberal," with only 19 (17.1%) identifying as either "very conservative," "conservative," or "somewhat conservative" and 18 (16.2%) identifying as "neither liberal nor conservative" and identifying as either "very conservative," "conservative," or "somewhat conservative." A chi-square test affirmed that distribution of political affiliation did not differ significantly between experimental and control groups ($\chi^2 = 5.10$; $p = .531$).

As for parental education, 86 (77.5%) participants reported having at least one parent who has completed a 4-year college degree or higher, with only 4 (3.6%) reporting having parent(s) who did not complete any form of college education (with the other 21 (18.9%) reporting having parent(s) who have completed "some college/associate's degree"). A chi-square test affirmed that distribution of parental education did not differ significantly between treatment groups ($\chi^2 = 3.00$; $p = .391$).

In regards to self-reported dietary patterns[3], outside of the 44 already excluded from the sample, 61 (55.0%) participants identified as "omnivores," 8 (7.2%) as "pesco-vegetarians[4]," and 42 (37.8%) "part-time vegetarians." A chi-square test affirmed that distribution of self-reported dietary behavior did differ significantly between control and experimental groups ($\chi^2 = 8.98$; $p = .011$), reflecting a larger proportion of self-reported omnivores in the experimental group. The distribution is depicted on the following page, in table 1.

[3] A detailed description of how these self-reported dietary patterns were assessed is included in the "Measures" section.

[4] Pesco-vegetarians were included in the sample because fish is included in our definition of meat (i.e., "animal flesh that is consumed as food, including chicken, beef, pork, fish, other seafood, etc.)

Table 1

Comparison between Treatment Groups of Self-Reported Dietary Behaviors

	Control Group	Experimental Group	Total Sample
Part-Time Vegetarian	23/58 (39.7%)	19/53 (35.8%)	42/111 (37.8%)
Pesco-Vegetarian	8/58 (13.8%)	0 (0.0%)	8/111 (7.2%)
Omnivore	27/58 (46.6%)	34/53 (64.2%)	61/111 (55.0%)

Procedure

For recruitment, cooperating faculty members distributed recruitment flyers (see Appendix A) to students electronically via digital course platforms. A member of the research team then visited each of the four classes in person to explain the components of the enrollment process and to answer questions about the study. Students who were interested in the study clicked a link on the recruitment flyer to a baseline survey hosted on the electronic platform Qualtrics, where they were able to digitally sign a consent form and begin participation in the study. They were able to do this at any time between Thursday at 8 A.M. and Sunday at 5 P.M. on a given week[5]. The rest of the study was also conducted electronically.

When students began participation in the study, they were first randomly assigned into experimental and control groups via Qualtrics. They all then completed a brief baseline survey, which took approximately 5-10 minutes. This survey assessed levels of meat consumption, baseline rate of PEBs performed, and other psychological variables related to meat consumption, as well as demographics. For all meat-related questions, meat was defined as "animal flesh that is consumed as flesh, including chicken, beef, pork, fish, other seafood, etc."

[5] This specific enrollment time range, and each following time range, was enforced via a feature of Qualtrics that allows the study administrator to limit survey responses to specific times.

At the end of the survey, the experimental group also received an intervention in the form of a digital flyer encouraging participation in Meatless Monday (see Appendix B). This flyer aimed to prime environmental identity, increase awareness of the environmental impacts of meat production, activate social norms[6], and decrease perceived behavioral difficulty, with the ultimate goal of promoting decreased meat consumption on Monday. These flyer aims were selected because, in the literature review, each of the four behavioral factors were found to have been associated with reduced meat consumption, pro-environmental behavior, and/or positive spillover behavior in varying capacities. Therefore, it was anticipated that these factors, when presented collectively, would be at least moderately effective in motivating individuals to participate in Meatless Monday, as well as to engage in positive pro-environmental spillover behavior during the rest of the week.

After reading this flyer, participants in the experimental group only were asked about their relationship to the Meatless Monday movement, including prior awareness of the movement, past participation rates, and future participation intentions.

On the Sunday evening immediately following completion of the baseline survey, participants in both groups received an email with instructions stating that they would be emailed individual links to online food diaries each morning of the upcoming week (Monday through Sunday, seven separate emails) and that they would have 48 hours to complete each daily entry before the link expired, so as to increase reporting accuracy of the food consumed. For example, Monday's food diary, emailed to participants at 8 A.M. Monday morning, would have to be completed before 8 A.M. Wednesday morning. The diaries were to be emailed in the morning so that participants would ideally have the option of completing the relevant portion of each food diary entry immediately after each individual meal was consumed (e.g., documenting what was eaten for breakfast immediately after breakfast).

Additionally, the Sunday email reminded participants that completion of each food diary entry earned them an additional entry into the aforementioned drawing for a $75 gift card. Finally, for the experimental group only, the Sunday evening email contained a reminder about the opportunity to participate in Meatless Monday the next day.

[6] A description of the role social norms may play in motivating PEB is included in Appendix E.

Following this Sunday evening email, both groups received the exact same treatment, starting with the seven daily food diaries. These daily food diaries were very brief and simple in nature, and were estimated to take a total of only 2-3 minutes to complete each day (see Appendix C).

Finally, on Monday morning of the following week (the week after the first Monday food diary link was sent), each participant was emailed a brief follow-up survey (5-10 minutes), and was again given 48 hours to complete it. This survey assessed the same variables as did the baseline survey, with the exception of demographics and questions related to Meatless Monday for the experimental group.

Measures

The baseline and follow-up surveys assessed the following factors: (1) demographics- baseline only; (2) current meat consumption behavior- baseline only; (3) prior awareness of Meatless Monday- baseline/experimental group only; (4) past engagement/future intention to engage in Meatless Monday- baseline/experimental group only; (5) rate of PEBs performed over the course of a week; (6) awareness of the environmental impacts of meat production; (7) environmental identity; (8) perceptions regarding abstention from meat consumption (including perceived behavioral difficulty); and (9) cognitive accessibility of environmental factors associated with diet. Measures used to assess these factors are described below.[7]

To assess current meat consumption behavior (baseline only), two measures were adapted from previous studies (Mullee et al., 2017; Cordts, Nitzko, and Spiller, 2014). The first, used as an exclusionary criterion, assessed self-reported dietary patterns by asking participants to "indicate of the following dietary patterns most closely represents your current diet," with the following options: (1) vegan- "no animal products"; (2) vegetarian- "no meat or fish"; (3) almost vegetarian- "eating meat or fish only on exceptional occasions; (4) part-time vegetarian- "eating meat or fish a few times a week"; (5) pesco-vegetarian- "no meat but eating fish"; and (6) omnivore- eating meat or fish on a daily basis or not intentionally abstaining from meat or fish.

[7] Factors 6-9 were not analyzed in this study for the specific purposes of evaluating H1-H3. Therefore, descriptions of these measures are included in the appendix. Demographics are described in the "Participants" section.

The second asked participants “within the last seven days, how often did you eat meat…” for breakfast, lunch, dinner, and snack(s), with options ranging from 0 to 7 days for each meal. For example, a response of “3 days” for lunch would indicate that, during the last week, the participant consumed meat-containing lunches three times. A new variable, “baseline meat-containing meals per week,” was thus calculated by summing the total reported meat-containing meals from each of breakfast, lunch, dinner, and snack(s).

To assess the experimental group’s prior awareness of Meatless Monday, participants were asked to indicate their level of awareness of the movement prior to reading the flyer by way of a five-point Likert scale, with 1 = “not at all aware” and 5 = “extremely aware.”

To assess the experimental group’s past engagement in Meatless Monday, participants were asked to answer “yes” or “no” to the following questions: “have you ever participated in Meatless Monday?” and “did you participate in Meatless Monday in the last week?” To assess the experimental group’s future engagement intentions, participants were asked to answer “yes,” “maybe,” or “no” to the following question: “do you intend to participate in Meatless Monday?”

To assess the rate of PEBs performed, a measure was adapted from a previous study (Brick, Sherman, & Kim, 2017). Using a five-point Likert scale, with 1 = “never” and 5 = “always,” it asked how often participants performed each of 12 PEBs in the past week, including “carrying a reusable water bottle,” “taking public transportation instead of taking a car,” and “eating organic food.” Participants reported PEBs performed both at baseline and a follow-up. The full list of the 12 PEBs assessed in both surveys is provided on the following page, in table 2.

Table 2

List of 12 PEBs Assessed on Each Survey

PEBs Assessed (adapted from Brick, Sherman, and Kim, 2017)
1. Walk, bicycle, or take public transportation instead of taking a car
2. Print on both sides of a sheet of paper
3. Carry a reusable water bottle
4. Act to conserve water when showering, cleaning, clothes, dishes, or other uses
5. Use reusable bags when shopping
6. Sort out your recycling
7. Eat organic food
8. Eat locally-sourced food
9. Use the stairs instead of the elevator when going up or down more than one flight
10. Turn off the lights in an empty room where you live
11. Turn your personal electronics off or into low-power mode when not in use
12. Eat animal products such as milk, cheese, eggs, or yogurt

The food diaries (see Appendix C) assessed daily food/meat consumption per meal. To assess this, participants were asked to "briefly describe what food they ate for each meal (e.g., chicken sandwich with side salad), and whether or not each meal contained meat." For each meal (breakfast, lunch, dinner, and snack(s)), participants were given a small space for these brief qualitative descriptions, and then responded either "yes" or "no" to the following question: "did the meal contain meat?" Meat was again defined as "animal flesh that is consumed as food, including chicken, beef, pork, fish, other seafood, etc.," with this definition appearing on each individual food diary.

Results

H1

Before testing H1, the differences in self-reported baseline meat consumption between the experimental and control group were analyzed. This analysis utilized the newly calculated variable, “baseline meat-containing meals per week” (described in the “Measures” section), as well as reported meat-containing for each of breakfast, lunch, dinner, and snack(s) . While the experimental group did report a slightly higher mean number of meat-containing meals for each meal than did the control group, as well as a higher mean total for the week, an independent samples t-test revealed that none of these baselines differences were statistically significant. Results are displayed below, in table 3.

Table 3

Reported Frequency of Meat-Containing Meals During Baseline Week

	Control Group $\bar{x}$	Experimental Group $\bar{x}$	T-Test Statistics
Baseline Meat-Consuming Meals for Breakfast	1.93 (σ = 1.58)	2.30 (σ = 1.66)	$t(106.9) = -1.20$
Baseline Meat-Containing Meals for Lunch	4.17 (σ = 2.15)	4.32 (σ = 2.14)	$t(108.2) = -.37$
Baseline Meat-Containing Meals for Dinner	5.16 (σ = 2.30)	5.64 (σ = 1.72)	$t(105.0) = -1.27$
Baseline Meat-Containing Meals for Snack(s)	1.34 (σ = 0.87)	1.55 (σ = 1.15)	$t(96.4) = -1.04$
Total Baseline Meat-Containing Meals	12.60 (σ = 5.43)	13.81 (σ = 4.40)	$t(107.5) = -1.29$

†p<.10, *p<.05, **p<.01, ***p<.001

Then, to test H1, independent samples t-tests were run to compare meat consumption on Monday between treatment groups, both on an aggregate and per-meal level. The data for these t-tests was taken from the Monday food diaries, which assessed meat consumption per meal. Responses of "yes" to the question "did the meal contain meat?" were coded as 1, whereas responses of "no" were coded as 0. Based on this coding, a new binary variable, "meat on Monday," was calculated to indicate whether the participant had consumed meat at all on Monday (i.e., a 1 was coded for at least one of the four meals). New variables were also created from these binary food diary responses to calculate the ratio of meat-containing meals reported for each of breakfast, lunch, dinner, and snack(s), as well as for Monday overall. It should be noted that the total reported number of meals consumed differed among breakfast, lunch, dinner, and snack(s), as some participants did not report consuming any food for certain meals (indicated by qualitative responses of "N/A" on food diary entries).

On Monday, participants within the experimental group reported consuming meat for 30.9% of meals, whereas participants within the control group reported consuming meat for 31.7% of meals. An independent samples t-test revealed that the difference was not statistically significant (p = .903). Furthermore, 32/53 (60.4%) of the experimental group reported consuming meat at least once on Monday, whereas 40/58 (69.0%) of the control group reported doing so. While the percentage of participants who reported consuming meat on Monday was descriptively lower for the experimental group, a t-test again revealed that the difference was not statistically significant (p = .350). Finally, when comparing groups' reported meat consumption for individual meals, including breakfast, lunch, dinner, and snack(s), independent samples t-tests once more revealed that any differences were not statistically significant. Results are displayed in table 4 on the following page, with mean decimal values having been converted to percentages for ease of interpretation.

Table 4

Comparison between Treatment Groups of Reported Percentages of Meat-Containing Meals on Monday Following Intervention

	Control Group	Experimental Group	T-Test Statistics
% of Participants who Consumed Meat at all on Monday	69.0% (40/58)	60.4% (32/53)	$t(106.7) = .94$
% of Participants who Consumed Meat for Monday Breakfast	6.4% (3/47)	9.1% (4/44)	$t(84.6) = -.48$
% of Participants who Consumed Meat for Monday Lunch	57.7% (30/52)	48.9% (22/45)	$t(92.6) = .86$
% of Participants who Consumed Meat for Monday Dinner	51.9% (28/54)	54.9% (28/51)	$t(102.7) = -.31$
% of Participants who Consumed Meat for Monday Snack	4.4% (2/46)	2.6% (1/38)	$t(81.8) = .43$
Total % of Meat-Containing Meals on Monday	31.7% (63/199)	30.9% (55/178)	$t(370.9) = .16$

†p<.10, *p<.05, **p<.01, ***p<.001

Note. Denominators of meal counts (in parentheses) vary because some participants reported not consuming any food for certain meals.

An analysis of the experimental group in isolation shed further light on the relative ineffectiveness of the Meatless Monday intervention in motivating actual abstention from Monday meat consumption. Indeed, when the 53 participants of the experimental group were asked if they intended to participate in Meatless Monday after receiving the intervention, only

24 (45.3%) responded “yes,” while 20 (37.8%) responded “maybe,” and 9 (17%) responded “no.” Then, among these three groups, actual meat consumption on Monday varied widely and did not always align with stated intentions, as shown below in table 5.

Table 5

Reported Percentages of Meat-Containing Meals on Monday within Experimental Group, Categorized by Responses to Question: “Do You Intend to Participate in Meatless Monday?”

	“Yes”	“Maybe”	“No”
% of Participants who Consumed Meat at all on Monday	37.5% (9/24)	80% (16/20)	77.8% (7/9)
% of Participants who Consumed Meat for Monday Breakfast	9.5% (2/21)	11.8% (2/17)	0% (0/6)
% of Participants who Consumed Meat for Monday Lunch	25% (5/20)	66.7% (12/18)	71.4% (5/7)
% of Participants who Consumed Meat for Monday Dinner	26.1% (6/23)	75% (15/20)	87.5% (7/8)
% of Participants who Consumed Meat for Monday Snack	25% (6/24)	25% (5/20)	20% (1/5)
Total % of Meat-Containing Meals on Monday	21.6% (19/88)	45.3% (34/75)	50% (13/26)

Note. Denominators of meal counts (in parentheses) vary because some participants reported not consuming any food for certain meals.

When considering the results of table 5, it should also be noted that for those who initially reported indecision regarding participation in Meatless Monday (the “maybe” group), very few

(4/20) actually did abstain from meat consumption on Monday, reflecting a possible disconnect between intent and actual behavior.

Ultimately, the data show that the intervention was ineffective in motivating significant reductions in meat consumption on Monday. Therefore, H1 ("individuals who receive an intervention encouraging participation in Meatless Monday will consume significantly less meat on Monday, relative to no-intervention controls") was not supported.

H2

To test H2, the binary responses to the repeated food diary question "did the meal contain meat?" were again analyzed, considering binary responses throughout the rest of the week. Ten new variables, which can be seen in tables 6 and 7, were created based on these responses. Five of these variables were created to calculate the ratio of meat-containing meals reported for each of breakfast, lunch, dinner, and snack(s) from Tuesday through Sunday, as well as aggregate totals for that period. The other five were then created to calculate the same aforementioned ratios, but from *Monday* through Sunday. Each of the variables (e.g., "meat-containing meals for breakfast throughout the week, incl. Monday") was computed by summing the 1's and 0's for "yes" and "no" responses for each meal for each of the seven days. This approach was selected due to the fact that participants completed different numbers of food diaries (5-7), as well as the fact that for certain meals, participants reported consuming no food at all.

As for the results, evidence was found for the opposite effect from what was predicted in H2, namely, that individuals who received the intervention actually reported consuming significantly *more* meat-containing meals the rest of the week, relative to controls. This effect was found by conducting separate independent samples t-tests for the first five newly created variables (Tuesday through Sunday), comparing the mean number of meat-containing meals for each of breakfast, lunch, dinner, and snack(s) between groups, as well as the aggregate totals.

Within the experimental group, participants reported consuming meat for 39.0% of meals during the rest of the week, whereas participants within the control group reported consuming meat for only 31.6% of meals. An independent samples t-test revealed that the difference was statistically significant ($p < .001$). Indeed, the reported percentages of meat-containing meals

trended higher for the experimental group for each of the four meals, with breakfast and dinner being significantly higher (p = .010 and .026, respectively). Results are displayed below, in table 6.

Table 6

Comparison between Treatment Groups of Reported Percentages of Meat-Containing Meals from Tuesday through Sunday Following Intervention

	Control Group	Experimental Group	T-Test Statistics
% of Meat-Containing Meals for Breakfast (excl. Monday)	10.6% (29/274)	18.7% (44/235)	$t(442.2) = -2.58$*
% of Meat-Containing Meals for Lunch (excl. Monday)	46.6% (131/281)	52.7% (136/258)	$t(533.0) = -1.41$
% of Meat-Containing Meals for Dinner (excl. Monday)	57.3% (185/323)	66.1% (185/280)	$t(595.1) = -2.22$*
% of Meat-Containing Meals for Snack (excl. Monday)	4.1% (10/245)	7.1% (14/198)	$t(364.1) = -1.35$
Total % of Meat-Containing Meals (excl. Monday)	31.6% (355/1123)	39% (379/971)	$t(2016.6) = -3.55$***

†p<.10, *p<.05, **p<.01, ***p<.001

Note. Denominators of meal counts (in parentheses) vary because some participants reported not consuming any food for certain meals.

Similar results were also found when considering the week in totality (Monday through Sunday) and conducting independent samples t-tests for the other five newly created variables, as shown on the following page in table 7. These results thus show an association between exposure to the intervention and increased meat consumption throughout the week.

Table 7

Comparison between Treatment Groups of Reported Percentages of Meat-Containing Meals from Monday through Sunday Following Intervention

	Control Group	Experimental Group	T-Test Statistics
% of Meat-Containing Meals for Breakfast (incl. Monday)	10.0% (32/321)	17.2% (48/279)	$t(528.2) = -2.57$*
% of Meat-Containing Meals for Lunch (incl. Monday)	48.4% (161/233)	52.2% (158/303)	$t(628.4) = -.96$
% of Meat-Containing Meals for Dinner (incl. Monday)	56.5% (213/377)	64.4% (213/331)	$t(699.5) = -2.14$*
% of Meat-Containing Meals for Snack (incl. Monday)	4.1% (12/291)	6.4% (15/236)	$t(450.3) = -1.16$
Total % of Meat-Containing Meals (incl. Monday)	31.6% (418/1322)	37.8% (434/1149)	$t(2389.8) = -3.21$**

†p<.10, *p<.05, **p<.01, ***p<.001

Note. Denominators of meal counts (in parentheses) vary because some participants reported not consuming any food for certain meals.

Furthermore, when comparing the mean number of days throughout the week on which participants reported consuming meat at least once, the mean number was almost one full day *higher* for the experimental group than for the control group. This effect held both when including and excluding Monday from the calculation. These results were generated by creating two new variables, “total meat-containing days, incl. Monday” and “total meat-containing days, excl. Monday.” These variables were calculated by summing the number of days (up to 7 or 6,

respectively) for which a coded variable response of 1 (indicating meat consumption) was reported for at least one meal.

When excluding Monday (i.e., assessing meat consumption Tuesday through Sunday), the mean number of meat-consuming days reported was 3.74 for the control group and 4.71 for the experimental group, and when including Monday, the mean number reported was 4.43 for control and 5.32 for experimental. Independent samples t-tests revealed that these differences between treatment groups in mean number of meat-consuming days were indeed significant, both when excluding and including Monday (p = .003 and .018, respectively). These results are displayed below, in table 8.

Table 8

Comparison between Treatment Groups of Mean Number of Days on which Meat was Consumed During Week Following Intervention

	Control Group $\bar{x}$	**Experimental Group $\bar{x}$**	**T-Test Statistics**
Mean # of Meat-Consuming Days (excl. Monday)	3.74 (σ = 2.08)	4.71 (σ = 1.28)	$t(95.8) = -3.00$**
Mean # of Meat-Consuming Days (incl. Monday)	4.43 (σ = 2.34)	5.32 (σ = 1.48)	$t(97.3) = -2.42$*

†p<.10, *p<.05, **p<.01, ***p<.001

Therefore, because the experimental group consistently reported higher levels of meat consumption throughout the week, H2 (“individuals who receive an intervention encouraging participation in Meatless Monday will consume significantly less meat the rest of the week, relative to controls”) was also not supported by the data.

H3

Before testing H3, a reliability analysis was conducted regarding 11 of the PEBs assessed on the baseline survey. The 12th PEB, which assessed the frequency with which participants consumed "animal products such as milk, cheese, eggs, or yogurt," was excluded from the reliability analysis due to its resemblance to prior questions assessing rates of meat consumption. The analysis demonstrated that such factors did not function well collectively as a scale (Cronbach's α = .607). The baseline PEBs were then analyzed individually, with two PEBs (carrying a reusable water bottle and turning off lights when exiting a room) being eliminated due to excessive skewness (|skewness| = 2.434 and 1.590, respectively). Therefore, reported frequencies of nine PEBs were considered for the purposes of testing H3, which appear in table 9 below.

First analyzed were the differences in self-reported baseline PEBs between the experimental and control groups. Independent samples t-tests comparing the mean reported frequencies of each of the nine PEBs (measured on 5-point Likert scales from 1 - "never" to 5 - "always") revealed no significant baseline differences between the two treatment groups. Results are displayed on the following page, in table 9.

Table 9

Comparison between Treatment Groups of Mean Reported Frequency of PEBs Performed During Baseline Week

Baseline PEBs ("In the past week, how frequently did you engage in the following behaviors?")	Control Group $\bar{x}$ (5-pt Likert scale; 1= never, 5= always)	Experimental Group $\bar{x}$ (5-pt Likert scale; 1= never, 5= always)	T-Test Statistics
1. Walk, bicycle, or take public transportation instead of taking a car	3.84 (σ = 1.06)	3.72 (σ = 1.18)	$t(104.7) = .60$
2. Print on both sides of a sheet of paper	3.78 (σ = 1.26)	3.53 (σ = 1.38)	$t(105.4) = .98$
3. Act to conserve water when showering, cleaning clothes, dishes, or other uses	3.52 (σ = 1.05)	3.32 (σ = 1.19)	$t(104.1) = .92$
4. Use reusable bags when shopping	3.62 (σ = 1.35)	3.58 (σ = 1.37)	$t(107.9) = .14$
5. Sort out your recycling	3.71 (σ = 1.35)	3.64 (σ = 1.53)	$t(104.1) = .24$
6. Eat organic food	2.33 (σ = 0.87)	2.51 (σ = 0.93)	$t(106.1) = -1.06$
7. Eat locally-sourced food	2.40 (σ = 0.82)	2.45 (σ = 0.89)	$t(105.7) = -.35$
8. Use the stairs instead of the elevator when going up/down more than one flight	3.59 (σ = 1.21)	3.72 (σ = 1.17)	$t(108.7) = -.58$
9. Turn personal electronics off or into low-power mode when not in use	3.02 (σ = 1.32)	2.85 (σ = 1.25)	$t(108.9) = .69$

†p<.10, *p<.05, **p<.01, ***p<.001

After conducting this baseline analysis, another set of independent samples t-tests was performed to determine if significant differences existed in the mean reported frequencies of each PEB between the treatment groups during the week of the Meatless Monday intervention (based on the follow-up survey). The mean reported frequency only differed significantly for 1 out of 9 follow-up PEBs, printing on both sides of a sheet of paper. In this case, the mean reported frequency for the control group was *higher* than that of the experimental group (4.05 vs 3.44, $p = .033$). Results are displayed on the following page, in table 10.

Table 10

Comparison between Treatment Groups of Mean Reported Frequency of PEBs Performed During Week Following Intervention

Follow-Up PEBs ("In the past week, how frequently did you engage in the following behaviors?")	Control Group $\bar{x}$ (5-pt Likert scale; 1= never, 5= always)	Experimental Group $\bar{x}$ (5-pt Likert scale; 1= never, 5= always)	T-Test Statistics
1. Walk, bicycle, or take public transportation instead of taking a car	3.65 (σ = 1.16)	3.77 (σ = 1.12)	$t(101.1) = -.55$
2. Print on both sides of a sheet of paper	4.05 (σ = 1.30)	3.44 (σ = 1.57)	$t(91.4) = 2.16$*
3. Act to conserve water when showering, cleaning clothes, dishes, or other uses	3.47 (σ = 0.97)	3.40 (σ = 1.18)	$t(90.7) = .37$
4. Use reusable bags when shopping	3.72 (σ = 1.35)	3.71 (σ = 1.41)	$t(98.2) = .04$
5. Sort out your recycling	3.86 (σ = 1.32)	3.54 (σ = 1.56)	$t(92.4) = 1.11$
6. Eat organic food	2.40 (σ = 0.88)	2.31 (σ = 0.95)	$t(97.2) = .51$
7. Eat locally-sourced food	2.42 (σ = 0.80)	2.58 (σ = 1.03)	$t(88.0) = -.89$
8. Use the stairs instead of the elevator when going up/down more than one flight	3.65 (σ = 1.26)	4.00 (σ = 1.08)	$t(101.8) = -1.53$
9. Turn personal electronics off or into low-power mode when not in use	3.33 (σ = 1.19)	2.96 (σ = 1.37)	$t(93.8) = 1.48$

†p<.10, *p<.05, **p<.01, ***p<.001

Therefore, H3 ("individuals who receive an intervention encouraging participation in Meatless Monday will perform significantly more PEBs throughout the week, relative to no-intervention controls") was also not supported by the data.

Exploratory Analysis- Comparison of PEBs Performed between those who did and did not Engage in Meatless Monday

Because the intervention was found to be largely ineffective in motivating study participants to actually abstain from meat consumption on Monday, a further exploratory analysis was conducted to determine whether behavioral spillover may have occurred between those who actually engaged in Meatless Monday and the rest of the sample, as opposed to simply comparing the experimental group to the control group. Actual engagement in Meatless Monday was defined for these purposes as those participants within the experimental group who responded either "yes" or "maybe" when asked if they intended to participate in Meatless Monday, and who then did not consume any meat on Monday. By this definition, there were 19 participants who actually engaged in Meatless Monday, out of 53 members of the experimental group and 111 members of the entire sample. A new binary grouping variable, "Meatless Monday engagement" was coded based upon these factors.

In regards to PEBs,[8] again analyzed were the differences in self-reported baseline PEBs between the two aforementioned groups, namely, between those who engaged in Meatless Monday and those who did not. Independent samples t-tests revealed that the only statistically significant difference was once more in relation to PEB #2 (printing on both sides of a sheet of paper), which the non-Meatless Monday engagement group reported performing significantly *more often* than did the engagement group ($\bar{x}$ = 3.77 vs 3.11, p = .044). Results are displayed on the following page, in table 11.

[8] Note that potential behavioral spillover in the form of differences in meat consumption during the rest of the intervention week (Tuesday-Sunday) was not tested for, given that statistically significant differences in baseline meat consumption were reported between these two groups.

Table 11

Comparison of Mean Reported Frequency of PEBs Performed During Baseline Week, Grouped by those who Engaged in Meatless Monday and those who did not

Baseline PEBs ("In the past week, how frequently did you engage in the following behaviors?")	Non-MM Engagement $\bar{x}$ (5-pt Likert scale; 1= never, 5= always)	MM Engagement $\bar{x}$ (5-pt Likert scale; 1= never, 5= always)	T-Test Statistics
1. Walk, bicycle, or take public transportation instead of taking a car	3.77 (σ = 1.12)	3.84 (σ = 1.12)	$t(26.0) = .25$
2. Print on both sides of a sheet of paper	3.77 (σ = 1.27)	3.11 (σ = 1.45)	$t(24.0) = -1.86^{\dagger}$
3. Act to conserve water when showering, cleaning clothes, dishes, or other uses	3.43 (σ = 1.14)	3.37 (σ = 1.01)	$t(28.3) = -.25$
4. Use reusable bags when shopping	3.53 (σ = 1.35)	3.95 (σ = 1.31)	$t(26.6) = 1.25$
5. Sort out your recycling	3.72 (σ = 1.41)	3.47 (σ = 1.58)	$t(24.3) = -.62$
6. Eat organic food	2.37 (σ = 0.91)	2.63 (σ = 0.83)	$t(27.7) = -1.23$
7. Eat locally-sourced food	2.43 (σ = 0.86)	2.37 (σ = 0.83)	$t(26.5) = -.32$
8. Use the stairs instead of the elevator when going up/down more than one flight	3.61 (σ = 1.20)	3.84 (σ = 1.17)	$t(26.4) = .79$
9. Turn personal electronics off or into low-power mode when not in use	2.97 (σ = 1.33)	2.79 (σ = 1.03)	$t(31.7) = -.65$

†p<.10, *p<.05, **p<.01, ***p<.001

However, when comparing follow-up PEBs, the Meatless Monday engagement group reported performing two PEBs significantly more often than did the non-engagement group, namely PEB #1 ("walk, bicycle, or take public transportation instead of taking a car") and PEB #4 ("use reusable bags when shopping"). Results are shown on the following page, in table 12.

Table 12

Comparison of Mean Reported Frequency of PEBs Performed During Week Following Intervention, Grouped by those who Engaged in Meatless Monday and those who did not

Follow-Up PEBs ("In the past week, how frequently did you engage in the following behaviors?")	Non-MM Participant $\bar{x}$ (5-pt Likert scale; 1= never, 5= always)	MM Participant $\bar{x}$ (5-pt Likert scale; 1= never, 5= always)	T-Test Statistics
1. Walk, bicycle, or take public transportation instead of taking a car	3.60 (σ = 1.17)	4.16 (σ = 0.83)	$t(35.7) = 2.41$*
2. Print on both sides of a sheet of paper	3.86 (σ = 1.44)	3.37 (σ = 1.50)	$t(25.9) = -1.30$
3. Act to conserve water when showering, cleaning clothes, dishes, or other uses	3.45 (σ = 1.05)	3.37 (σ = 1.17)	$t(24.8) = -.29$
4. Use reusable bags when shopping	3.59 (σ = 1.41)	4.26 (σ = 1.05)	$t(34.2) = 2.36$*
5. Sort out your recycling	3.76 (σ = 1.41)	3.53 (σ = 1.58)	$t(24.7) = -.59$
6. Eat organic food	2.40 (σ = 0.91)	2.21 (σ = 0.92)	$t(26.4) = -.80$
7. Eat locally-sourced food	2.45 (σ = 0.89)	2.68 (σ = 1.00)	$t(24.6) = .93$
8. Use the stairs instead of the elevator when going up/down more than one flight	3.78 (σ = 1.19)	3.95 (σ = 1.22)	$t(26.2) = .55$
9. Turn personal electronics off or into low-power mode when not in use	3.17 (σ = 1.30)	3.11 (σ = 1.20)	$t(28.3) = -.22$

†p<.10, *p<.05, **p<.01, ***p<.001

Exploratory Analysis- Changes in Psychological Correlates from Baseline to Follow-Up among Experimental Group

Of further interest to the research team were changes in psychological correlates among the participants within the experimental group from baseline to follow-up, which could shed light on why the intervention was relatively ineffective in producing the hypothesized results. Assessed at both baseline and follow-up were environmental identity, perceptions regarding abstention from meat consumption (including behavioral difficulty), and awareness of the negative environmental impacts of meat consumption, each of which functioned as a scale (see Appendix D for measures). Paired samples t-tests were conducted to assess the extent that these factors changed from baseline to follow-up, with awareness of the negative environmental impacts of meat consumption increasing significantly[9], as shown in table 13.

Table 13

Analysis of Changes in Psychological Correlate Scales from Baseline to Follow-Up among Experimental Group

Scale	Mean Change from Baseline to Follow-Up	T-Test Statistics
Environmental Identity	-.10 ($\sigma = 0.65$)	$t(47.0) = 1.03$
Perceptions Regarding Abstention from Meat Consumption One Day/Week	-.08 ($\sigma = 0.66$)	$t(47.0) = 0.83$
Awareness of the Negative Environmental Impacts of Meat Consumption	+.22 ($\sigma = 0.71$)	$t(47.0) = -2.13$*

†p<.10, *p<.05, **p<.01, ***p<.001

Note. Each scale was assessed via seven-point Likert scales, with a positive numerical change representing a positive change (e.g., increased positive perceptions regarding abstention from meat consumption one day per week), and vice versa.

[9] Paired samples t-tests revealed no significant changes in scales from baseline to follow-up for the control group.

Additional paired samples t-tests were conducted to assess changes for each individual factor of the perceptions regarding abstention from meat consumption scale. Significant changes were found in regards to perceptions regarding how easy it would be to abstain from meat consumption one day per week, with a decrease of behavioral ease/increase in perceived behavioral difficulty at follow-up, and how much of a positive environmental impact such behavior would have, with an increase in perceived positive impact[10], as shown in table 14.

Table 14

Analysis of Changes in Specific Measures from Perceptual Scale from Baseline to Follow-Up among Experimental Group

Scale Measure- Perceptions Regarding Abstention from Meat One Day/Week	Mean Change from Baseline to Follow-Up	T-Test Statistics
Level of Ease	-.48 ($\sigma = 1.50$)	$t(47.0) = 1.03$*
Level of Convenience	-.27 ($\sigma = 1.70$)	$t(47.0) = 0.83$
Extent to which the Taste would Taste Good	-.23 ($\sigma = 1.04$)	$t(47.0) = -2.13$
Extent to which Family and Friends would Encourage the Behavior	+.13 ($\sigma = 1.18$)	$t(47.0) = -.735$
Extent to which Behavior would have Positive Environmental Impact	+.46 ($\sigma = 1.41$)	$t(47.0) = -2.25$*

†p<.10, *p<.05, **p<.01, ***p<.001

Note. Each scale measure was assessed on a seven-point Likert scale, with a positive numerical change representing a positive change (e.g., an increased perception of the positive impact the behavior would have on the environment), and vice versa.

[10] Paired samples t-tests revealed no significant changes from baseline to follow-up in any individual perpetual factor for the control group.

Discussion

In all, each of the three hypotheses were rejected. Regarding H1, participants who received the intervention encouraging participation in Meatless Monday did not consume significantly less meat on Monday, relative to no-intervention controls. In regards to the ineffectiveness of the intervention in promoting engagement in Meatless Monday, one possible explanation relates to the temporal gap between participants' exposure to the flyer and to the actual decision point of whether or not to consume meat on Monday. Because participants were able to complete the baseline survey as early as Thursday at 8 A.M. on a given week, some participants may have had a gap of almost 100 hours between the time that they read the flyer and the time that they first consumed food on Monday. This potential temporal gap does not align well with research findings that suggest that just-in-time interventions may be more effective in facilitating positive behavior change, by providing behavioral support at the exact decision point, when it is most needed (Nahum-Shani et al., 2014; Thomas & Bond, 2015). Indeed, the potential temporal gap in this study may have made the Meatless Monday messaging more psychologically distant, and thus contributed to decreased intervention effectiveness. It should be noted that participants were reminded in their Sunday night instructional email about the potential to engage in Meatless Monday the following day, but this reminder was only cursory in nature and did not contain the different psychological mechanisms such as environmental identity and social norms that were incorporated in the flyer. Furthermore, participants may have simply neglected to open the Sunday night email, and thus forgotten about Meatless Monday before consuming meat on that day.

Another possible explanation relates to the lack of a manipulation check verifying that participants actually read the electronic flyer. Indeed, especially in consideration of the relatively long length of the flyer (see Appendix B), it is possible that participants simply scrolled and clicked through the electronic flyer without fully understanding and considering its messaging. This was a significant shortcoming in the survey methodology. However, because exploratory analyses revealed that both awareness of the negative environmental impacts of meat consumption and perceptions of the potential environmental impact of abstention from meat consumption increased significantly at follow-up, this would not seem to entirely explain the

ineffectiveness of the intervention, given that the intervention did indeed have a significant effect on these factors.

However, exploratory analyses revealed a potential alternate explanation, namely, that at baseline participants may have underestimated the difficulty of abstention from meat consumption one day per week, as it was found that perceived behavioral difficulty increased significantly at follow-up. Indeed, when confronted with the actual decision of whether or not to consume meat on Monday, participants may have been unable to break from previously-formed habits of meat consumption, or may have realized that they did not have adequate meat substitutes available, among other many other possible barriers (Stoll-Kleemann & Schmidt, 2017). These effects then could have led to lower rates of engagement in Meatless Monday.

Additionally, it is important to consider the format of intervention used. A growing body of literature has demonstrated that informational interventions can be relatively ineffective when compared to other forms of behavioral interventions (e.g., Stöckli, Niklaus, & Dorn, 2018), and indeed, the intervention used in the study was largely informational. Therefore, it is quite possible that a greater percentage of participants would have engaged in Meatless Monday and reduced their cumulative meat consumption had another form of intervention been utilized. This point is significant because much of the messaging used to promote the Meatless Monday campaign in reality is also informational, and thus may not be maximally effective in promoting engagement in the movement. The results in this study suggest that campaigners would be well-suited to consider other forms of behavioral interventions when promoting Meatless Monday, in addition to informational messaging.

Relatedly, the intervention in this study focused on environmental-related messaging, as opposed to health-related messaging, which may have limited its effectiveness. Indeed, research has shown that health-related messaging is often more effective than environmental-related messaging in promoting positive behavior change (e.g, Latvala et al., 2012; Neff, Edwards, & Palmer, 2018). These prior findings are particularly germane to this study because exploratory analyses found that the experimental group's awareness of the negative impacts of meat production increased significantly, as did its perception of the positive environmental impacts of abstaining from meat consumption, but despite this, its actual meat consumption did not decrease significantly. Therefore, it is evident that environmental awareness and

environmental-related messaging was largely ineffective in motivating positive behavior change among the sample, and as such, it is possible that health-related messaging may have been more effective.

Finally, it should be noted that the initial randomization of participants into experimental and control groups partially failed. At baseline, the experimental group reported consuming over one additional meat-containing meal of the course of a week when compared to the control group, though this effect was not statistically significant. However, distribution of self-reported dietary patterns did differ significantly between treatment groups, with the experimental group composed of a significantly higher percentage of omnivores, as opposed to part-time and pesco-vegetarians. Therefore, it is possible that higher rates of meat consumption for the experimental group at baseline limited the ability for significant decreases in meat consumption to be observed on Monday, relative to the control group.

Many of these same factors that likely impacted H1 also likely impacted the results of H2 and H3. For H2, the experimental group reported consuming a significantly *higher* percentage of meat-containing meals throughout the intervention week, in addition to reporting a significantly higher mean number of days with any meat consumption. Again, these findings may potentially be attributed, at least in part, to the failed randomization at baseline between the two groups. Ultimately, however, the rejection of the H2 hypothesis is likely closely related to the ineffectiveness of the Meatless Monday intervention, as it would not be expected that participants would significantly reduce meat consumption on Tuesday through Sunday if they did not first significantly reduce meat consumption on Monday.

Similarly, for H3 and pro-environmental behavioral spillover, it was not expected that positive spillover would occur without first widespread adoption of the target behavior, namely, abstention from meat consumption on Monday. Therefore, because adoption of the target behavior was limited, the fact that a significantly higher rate of PEBs among the experimental group was not observed in comparison to controls limits our ability to draw strong conclusions about pro-environmental spillover behavior. Despite this, the finding that two of the nine PEBs were significantly higher among those who actually engaged in Meatless Monday could potentially reflect this kind of spillover (though it is also possible that this finding was simply due to chance). Regardless, it is certainly conceivable that a larger and more representative sample

(discussed below), coupled with higher rates of engagement in the target behavior, would have yielded much stronger evidence related to pro-environmental spillover behavior.

It should be noted also that evidence was not found for the negative spillover pathway proposed in Verfeuth et al., 2019, as a potential explanation for why the intervention was ineffective. In the study, it was proposed that conflicting identities would lead to the content of a given intervention to become less central to individuals, leading to weakening of environmental identity, reactive behavior, and negative spillover. However, exploratory analyses revealed that environmental identity (see Appendix D for measures) did not change significantly from baseline to follow-up among the experimental group. Thus, without significant weakening of environmental identity, the conflicting identities pathway would not be expected to have occurred. Indeed, it may be more likely that compartmentalization[11] effects occurred to at least a limited extent, reflective of a general lack of pro-environmental spillover behavior, though this cannot be wholly verified by the survey measures utilized in this study.

Limitations and Future Directions

There were multiple significant limitations of this study related to sample. Demographics of the participants were highly homogenous in many respects, including the following factors: (1) age- 90.1% between 18 and 22 years old; (2) gender- 68.5% female; (3) race- 93.7% white; (4) political affiliation- 66.7% liberal; and (5) parental education- 77.5% in situations where at least one parent had completed a 4-year college degree. The sample was also relatively small, with fewer than 60 participants assigned to each treatment group. The sample cannot be considered representative of the population at large; and future research is therefore needed to determine how effects might change with a more representative sample.

Additionally, because the majority of students within the sample were pursuing majors within SENR, these participants likely had far more knowledge of and interest in environmental issues than the general population. Indeed, participants scored highly on baselines scales[12] for

[11] Compartmentalization within the context of the Verfeuth et al. study describes a separation of the behavior from environmental identity and resultant lack of spillover, as outlined in the introduction.

[12] These were measured on seven-point Likert scales. Scale measures and reliability analyses for each of the three scales referenced in this paragraph are described in the appendix.

both environmental identity ($\bar{x}$ = 5.9, σ = .95) and awareness of the environmental impacts of meat production ($\bar{x}$ = 5.8, σ = 1.25), making it so that there was likely limited ability to increase these factors as a result of the Meatless Monday intervention. However, regarding environmental identity specifically, given the well-documented desire for humans to act consistently with their identities (e.g, Festinger, 1957; Thøgersen, 2004), it is somewhat unexpected that Meatless Monday engagement rates were not higher, given the prevalence of self-described environmentalists among the sample.

Similarly, participants reported relatively low levels of baseline perceived behavioral difficulty ($\bar{x}$ = 5.2, σ = 1.19) when considering the possibility of abstaining from meat one day per week, again potentially limiting the ability to facilitate a meaningful change as a result of the intervention. Because there are numerous meatless options offered through the university's dining services, it is certainly possible that this baseline perceived behavioral difficulty may have been lower for the sample than it would have been for the general population, given increased access to such meatless options and decreased need for actual meatless cooking skills. Therefore, future research is needed to ascertain how effective such an intervention might be in motivating reduced meat consumption and pro-environmental spillover behavior when the sample is more representative of the population in regards to environmental issues and perceptions regarding meat consumption, thus increasing the potential to motivate change in these respects.

Furthermore, future research is warranted to identify the specific factors that may have contributed to the relative ineffectiveness of the Meatless Monday intervention. Because multiple variables were assessed in the baseline and follow-up surveys that might reveal information about such factors (e.g., environmental identity, perceived behavioral difficulty, awareness of the negative environmental impacts of meat production), there is a significant opportunity for further data analysis at a future time, with only cursory exploratory analyses having been performed in this study. Further data analysis is also warranted to investigate the potential role of cognitive accessibility in mediating behavioral spillover among PEBs (see Appendix D, F). Additionally, there is justification for performing a similar study with a manipulation check to ensure that the intervention (in this case, the flyer) was actually read and fully understood, given the notable lack of such a check in this study.

Other future directions include the broader needs for additional study of meat consumption reduction interventions generally and the factors that may make them more or less effective. One possible area of exploration relates to the specific food consumed when people reduce their meat consumption without becoming fully vegetarian or vegan, about which little is currently known (Neff et al., 2018). A similar experimental design to that of this study, utilizing food diaries, could address this research gap, if the underlying factors that made the intervention ineffective were addressed. Also, future research investigating the conditions under which pro-environmental spillover behavior may occur, especially when adoption of the target behavior is more widespread, is justified. This area in particular is important so that policymakers may design more effective behavioral interventions that minimize negative spillover and maximize positive spillover.

Finally, additional experimental research into the Meatless Monday campaign from a broader perspective is necessary, both to address the limitations of the current study, and to expand upon them. Specifically, because the data revealed that meat consumption did not significantly decrease despite increased awareness of the negative environmental impacts of meat production, experimental research that compares the effectiveness of environmental-related messaging to health-related messaging for the purposes of promoting Meatless Monday is warranted. Indeed, because the campaign promotes abstention from meat consumption on Monday for both environmental and health reasons, if indeed health-related messaging were found to be more effective in motivating reduced meat consumption behavior, marketers would potentially be able to increase the effectiveness of Meatless Monday while still aligning with the campaign's stated intent.

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Appendix

A. Sample Digital Recruitment Flyer

THE OHIO STATE UNIVERSITY

Participate in a study about consumer food choices and environmental behavior

In this study, we're interested in learning about what factors influence people's food choices and related behaviors.

What's involved?
This study is entirely online. Participating involves responding to two brief surveys (5-10 minutes each) and completing a simple one-week food diary (2-3 minutes per day over the course of a week). Total participation is estimated to take 30-45 minutes over the course of approximately one week, and may begin on any day between Thursday and Sunday.

Who can participate?
To be eligible, you must be 18 years of age or older, and must be an Ohio State student taking a course with a cooperating instructor.

Compensation
If you participate in this study, you may receive two forms of compensation:

1) You will be eligible to receive extra credit in the form of a 1.25% increase in your ENR 3200 course grade. For example, if your course grade is 88.75%, and you participate in the study, your final course grade would increase to 90%.

2) In addition, for each food diary you respond to, you will receive one entry into a drawing to receive a $75 gift card of your choice.

Want to participate?
If you are interested in participating, please complete the following brief survey at any time between Thursday at 8 AM and Sunday at 5 PM during a given week:
https://tinyurl.com/osubehaviorstudy

On Sunday night, given successful completion of the survey, you will be emailed further instructions regarding the next steps in the study to be taken in the following week.

Have questions?
If you have questions about the study, please email Stephen Mattson at mattson.42@osu.edu.

Additionally, for questions about your rights as a participant in this particular study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact the Office of Responsible Research Practices at 1-800-678-6251.

B. Meatless Monday Flyer

MEATLESS MONDAY

Are you concerned about the environment and climate change?
Looking for easy ways to make a difference?

Then join the millions of others who have pledged to go Meatless on Monday!

Meatless Monday is a global movement with a simple message: **one day a week, don't eat meat.** The movement aims to address the many negative environmental impacts of animal agriculture by reducing global meat consumption by up to 15%. Here are just a few facts demonstrating the gravity of these environmental problems:

Global meat production…

… contributes disproportionately to global warming.

- **14.5% of global greenhouse gas emissions** are attributable to the livestock industry annually, equivalent to annual emissions from **over 1.2 billion passenger vehicles**
  (Gerber et al., 2013), (EPA, 2018)

… is highly inefficient compared to plant-based food production.

- **Over 27 pounds of plant biomass** are required for **every pound of meat produced**
  (Smith et al., 2013)

… is highly water intensive.

- **1,847 gallons of water** are required to produce **a single pound of beef,** and **518 gallons** for **a pound of chicken,** compared to **115 gallons** for **fruit** and **39 gallons** for vegetables
  (Mekonnen and Hoekstra, 2010)

… is highly land intensive.

- **Over 75% of deforested land in the Amazon** has been converted to pasture or feed crops
  (Nepstad et al., 2008)

… leads to further problems associated with monoculture, water pollution, nitrogen fertilizer, topsoil runoff, insecticide, waste management…

In face of these impacts, thousands of scientists around the world have called for drastic reductions in per capita meat consumption, with many experts describing reducing personal meat intake as **the single most environmentally beneficial action an individual can take.**

Fortunately, by participating in **Meatless Monday**, you will make a huge difference in helping to achieve these vital reductions. And you won't be alone! **Meatless Monday** has been practiced by millions of people in over 40 countries, has been endorsed by numerous celebrities, and has been adopted by an ever-growing number of Ohio State students.

Going **Meatless** on **Monday** is easy too! OSU Dining Services offers many tasty plant-based protein options that can still align with your nutritional goals, including sofritas tacos, veggie burgers, and vegetarian chicken nuggets. Grocery stores and restaurants also increasingly offer wide varieties of plant-based foods; some, like Bibibop and Ethyl & Tank, have actually offered discounts for **Meatless Monday** participants! And now, with the rapid growth of meat alternatives, you can still have the great taste of meat, but with plants! So join the movement and go **Meatless** on **Monday!**

The planet will thank you! :)

C. Sample Digital Food Diary

Please briefly describe what food you ate for each meal (e.g. chicken sandwich with side salad), and whether or not each meal contained meat. "Meat" will be defined as animal flesh that is consumed as food, including chicken, beef, pork, fish, other seafood, etc.

*If you do not eat any food for a given meal, please write "N/A."

**If you consumed multiple snacks on a single day, please briefly describe each snack (e.g. grapes; beef jerky; crackers), and indicate whether *any snack* on that day contained meat.

Monday

Breakfast:

Did the meal contain meat?

Yes

No

Lunch:

C. Sample Digital Food Diary (cont)

Did the meal contain meat?

Yes

No

Dinner:

Did the meal contain meat?

Yes

No

Snack(s):

Did any snack contain meat?

Yes

No

D. Description of Additional Survey Measures

To assess awareness of the environmental impacts of meat production, two measures were modified from previous studies (Pohjolainen et al., 2016; Mullee et al., 2017). The resultant five questions asked, for example, the extent to which participants agreed that meat production is bad for the environment, and that meat production is significantly more land-intensive than plant production, among other criteria. Participants responded via seven-point Likert scales (1 = "strongly disagree," 7 = "strongly agree"). A reliability analysis demonstrated that these factors functioned well as a scale (Cronbach's α = .902). Thus, a new scale variable, "awareness of the negative environmental impacts of meat production," was created, which averaged participants' numerical responses to these five questions.

To assess environmental identity, three questions were reproduced from a previous study (van der Werff et al., 2013). Using a seven-point Likert scale (1 = "strongly disagree," 7 = "strongly agree"), the items assessed the extent to which participants agreed with the following statements: "acting environmentally-friendly is an important part of who I am," "I am the type of person who acts environmentally friendly," and "I see myself as an environmentally-friendly person." A reliability analysis demonstrated that these factors functioned well as a scale (Cronbach's α = .892). Thus, a new scale variable, "environmental identity," was created, which averaged participants' numerical responses to these three questions.

To assess perceptions regarding abstention from meat consumption one day per week, including perceived behavioral difficulty, five questions were adapted from a previous study (Truelove & Gillis, 2018). These items asked participants to indicate, if they were to abstain from eating meat one day per week, "how difficult it would be," "how inconvenient it would be," "how the food would taste on that day," "how encouraging family and friends would be of your behavior," and "how much of a positive impact it would have on the environmental overall." Participants responded via seven-point Likert scales (e.g., 1 = "extremely difficult," 7 = "extremely easy"). A reliability analysis demonstrated that these factors functioned well as a scale (Cronbach's α = .785). Thus, a new scale variable, "perceptions regarding abstention from meat consumption one day per week," was created, which averaged participants' numerical responses to these five questions.

D. Description of Additional Survey Measures (cont.)

To assess cognitive accessibility of environmental factors related to diet (see Appendix F), two measures were modified from a previous study (Sintov et al., 2017). The resultant six questions assessed the extent to which participants considered the land, water, and energy used in production when choosing what food to buy and eat. For example, participants were asked the extent to which they agreed or disagreed with the following statement: "I consider the land that was used in production when I choose what kind of food to eat." Participants responded via seven-point Likert scales (1 = "strongly disagree, 7 = "strongly agree"). A reliability analysis demonstrated that these factors functioned well as a scale (Cronbach's α = .926). Thus, a new scale variable, "cognitive accessibility," was created, which averaged participants' numerical responses to these six questions.

E. Discussion of Social Norms

The potential influence of social norms was leveraged in the flyer as a potential means of increasing engagement in Meatless Monday, in tandem with environmental identity and other factors. Social norms can be defined as standards and rules that are collectively understood by members of a group, and that guide and/or constrain social behavior without the influence of laws (Cialdini & Trost, 1998). Social norms have been linked to behavioral spillover (Steinhorst, Klöckner, & Matthies, 2015). For example, research has demonstrated that people are more likely to engage in energy-saving behavior when interventions are framed as normative appeals, rather than as appeals to benefit the environment or save money (Nolan, Schultz, & Cialdini, 2008). Indeed, when intrinsic motivation for performing a PEB (i.e. to benefit the environment) is insufficient, social norms may provide the necessary external motivation to influence behavior and generate associated spillover effects (Nash et al., 2017).

Social norms were incorporated in the flyer by highlighting that "millions of people in over 40 countries" and an "ever-growing number of Ohio State students" were participating in Meatless Monday, thus reflecting that engagement with the campaign was a socially acceptable and relatively common practice among participants' peers. However, because the flyer was largely ineffective and because the only measure related to social norms (the extent to which family and friends would be encouraging of meat consumption reduction) did not show significant change from baseline to follow-up, it is difficult to evaluate the effect that social norms had on the target behavior, if any.

F. Discussion of Cognitive Accessibility

One relatively novel variable that has been proposed in relation to the environmental identity pathway is that of cognitive accessibility. The term "cognitive accessibility" refers to the frequency by which people think about certain ideas. It is related to the availability heuristic and self-perception theory, the well-documented tendencies for people to overweight information that can be mentally recalled immediately (Tversky & Kahneman, 1973; Schwarz et al., 1991; Pachur, Hertwig, & Steinmann, 2012), and to refer back to previous behaviors as representative of their self-concept (Bem, 1972), respectively, when making decisions. In an environmental context, cognitive accessibility refers to individuals' tendency to first think about prior PEBs when making decisions regarding future PEBs, and then to overweight past PEBs that are easiest to mentally recall (i.e. those that have occurred more recently or more frequently). As previously referenced, in a recent study, cognitive accessibility was hypothesized as a potential mediator between composting and spillover to other household waste prevention behaviors, and indeed, evidence was found to support this hypothesis in regards to certain waste prevention behaviors (Sintov, Geislar, & White, 2017).

However, it does not appear that further studies have investigated the potential role of cognitive accessibility as mediating spillover among PEBs, leaving a significant opportunity for further research. In regards to meat consumption, insofar as daily dietary choices offer repeated opportunities to engage in PEBs, cognitive accessibility may indeed mediate spillover to other PEBs, especially those in the same dietary behavioral domain. Therefore, while the potential role of cognitive accessibility was not directly analyzed in this study, specific measures related to cognitive accessibility were indeed included (see Appendix D), so as to invite further analysis in the future.